Citation:

Hare-Bruun H, Flint A, Heitmann BL. Glycemic index and glycemic load in relation to changes in body weight, body fat distribution, and body composition in adult Danes. *Am J Clin Nutr.* 2006 Oct; 84(4): 871-879.

PubMed ID: 17023715

Study Design:

Prospective Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To investigate the prospective relation between the glycemic index and glycemic load on the habitual diet and the subsequent six-year changes in body weight, body fat distribution and body composition in a random subset of the Danish population.

Inclusion Criteria:

- Adults from a random sample (4,581) of Danes born in 1922, 1932, 1942 and 1952 from the Danish centralized civil registration system in 1982 who were invited to participate in the Danish arm of the MONICA project, an international study conducted under the WHO
- And who (3,608) participated in a baseline health examination in 1982
- And who returned for another health exam between December 1987 and November 1988 and were chosen to participate in a dietary survey at the same time (552)
- And who participated in a follow-up exam six years later 1993 to 1994.

Exclusion Criteria:

- Subjects with missing data on body weight, height, waist circumference, hip circumference, body fat mass or lean body mass in one of the two health examinations or with missing data on one or more of the covariates
- Subjects diagnosed with diabetes before 1987 to 1988.

Description of Study Protocol:

Recruitment

Subset of Danish arm of MONICA trial participants drawn from a random sample of residents.

Design

Prospective cohort study.

Dietary Intake/Dietary Assessment Methodology

- A registered dietitian interviewed subjects on their dietary history
- Average dietary intake was based on intakes in the previous month
- Estimates of nutrient intakes were calculated with DANKOST software.

Statistical Analysis

- Tests for trend were performed using sex stratification for all variables and one factor analysis of variance with quintile medians for glycemic index and glycemic load, respectively, as independent variables
- Multiple linear regression analysis was used to examine associations between the exposure variables GI and GL and the outcome variables (change in body weight, change in percent body fat, change in waist circumference and change in hip circumference). Confounders were chosen a priori.
- Interactions were analyzed for GI or GL with leisure time physical activity (LTPA) and sex.

Data Collection Summary:

Timing of Measurements

- 1982: Baseline health examination
- December 1987 to November 1988: Health examination and dietary survey
- 1993 to 1994: Follow-up health examination.

Dependent Variables

- Body weight: SECA weighing scales
- Height
- Waist circumference: Point of maximum circumference over the buttocks
- Hip circumference: Horizontally midway between the lower rib margin and the iliac crest
- Body composition: Bioelectrical impedance
- Body fat: Algorithm based on body weight, age, height and sex
- Fat free mass: Difference between body weight and body fat mass.

Independent Variables

Weighted glycemic index and overall glycemic load: assigned to the diet of participants with the use of values from the 2002 international table of GI and GL values

Control Variables

Baseline of the outcome variable, age, smoking status, years of education, LTPA, energy intake, fat intake (percentage of energy), protein intake (percentage of energy) and dietary fiber intake.

Description of Actual Data Sample:

- *Initial N:* 552

- *Attrition (final N):* 376 (117 excluded due to missing follow-up data or diagnosis of type 2 diabetes at baseline)
- *Age:*
    - 30 to 60 years at baseline
    - Baseline mean (SD) age of subjects was stratified by sex and LTPA (sedentary, spend time mostly sitting; and active, all others)
        - Active men: 49.7 (10.9)
        - Sedentary men: 48.3 (9.8)
        - Active women: 50.0 (10.9)
        - Sedentary women: 48.6 (11.0)
- *Anthropometrics:*
    - Only small differences were present between included and excluded subjects after adjustment for age; excluded men had higher mean percentage body fat and waist circumference; excluded women had higher mean body weight and waist circumference
    - Mean (SD) of baseline variables:
        - Men, percentage body fat: 23.1% (6)
        - Men, waist circumference: 90.5cm (10.0)
        - Women, body weight: 64.3kg (10.2)
        - Women, waist circumference: 78.3cm (9.5)
- *Location:* Denmark.

Summary of Results:

Associations Between Baseline Dietary GI and Six-year Changes in Body Weight, Percentage Body Fat and Waist and Hip Circumference (N=376)

Variables	Men	Women
Log (body weight)	-0.0002 (-0.002, 0.002)	0.002 (0.0001, 0.004)
Percentage body fat	0.02 (-0.07, 0.11)	0.09 (0.004, 0.17)
Waist circumference	0.02 (-0.14, 0.17)	0.16 (-0.01, 0.32)
Hip circumference	-0.0003 (-0.10, 0.10)	0.08 (-0.05, 0.22)

* All values are beta regression coefficients (95% CI); adjusted for covariates.

Key Findings

- In sedentary women, there were significant associations between GI and obesity measures. In six years, values per 10-unit increase in baseline GI rose in sedentary women by 6% (95% CI: 2, 9%; P=0.001) for body weight, 3% (95% CI: 1, 4%; P=0.002) for percentage body fat, and 4 cm (95% CI: 1, 7%; P=0.008) for waist circumference
- The GI was not significantly associated with change in any of the obesity measures in men
- GL was not significantly associated with any of the outcome variables for men. In women, there was an inverse association between GL and changes in waist circumference in the adjusted analyses (P=0.06).

Author Conclusion:

- A low-GI diet may protect against increases in body weight and general and abdominal obesity in women, especially those who are sedentary, which suggests that physical activity may offer protection against diet-induced weight gain and obesity
- No effect of GI was observed in men.

Reviewer Comments:

Limitations: There was only one measure of diet (at baseline), which assumes that the diet does not change considerably during the follow-up period (this may have resulted in non-differential misclassification and led to conservative estimates of true associations).

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes

2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	???
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A

5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	???
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes

8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	???
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes